REMARKS

As requested in the accompanying Request for Change of Correspondence Address, please direct future communications regarding this application to: Roger R. Wise, PILLSBURY WINTHROP LLP, 725 S. Figueroa Suite 2800, Los Angeles, CA 90017.

Claims 1 - 6, 13 - 20, and 22 - 32 are pending. Claims 31 and 32 have been added. Claims 1 - 6, 13, 15 - 19, 22 - 26, and 28 - 30 have been amended. Claims 7 - 12, and 21 have been cancelled, without prejudice. No new matter has been introduced. Reexamination and reconsideration of the application are respectfully requested.

In the September 18, 2002 Office Action, the Examiner rejected claims 1 - 30 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,130,526 to Yang et al. (the Yang reference) in view of U.S. Patent No. 4,924,170 to Henze (the Henze reference). This rejection is respectfully traversed.

The present invention is directed to a method and power supply regulator for regulation of multiple supply voltages for microelectronics devices. The microelectronics device is designed to operate at two different supply voltages, V_{cc1} and V_{cc2}. A regulator circuit may be provided in an embodiment which includes two distinct regulator circuits (one being used to supply regulation for V_{cc1} and one being used to supply regulation for V_{cc2}). A first input voltage required value may be, for example, 2.0 V_{DC} and a second input voltage required value may be, for example, 1.4 V_{DC}. The principal supply voltage is operated within a specified tolerance window with an upper limit bound by a first reliability voltage value, V_{ccx}. The secondary supply voltage is

reliability voltage value. The principal supply voltage has a specified tolerance window for the lower limit bounded by a third reliability voltage value. The lower limit of the principal supply voltage is determined by multiplying (the difference of one minus a tolerance factor) times the first input voltage required value. The lower limit of the secondary supply voltage is determined by multiplying (the difference of one minus a tolerance factor) times the second input voltage required value.

Utilizing the example above, the primary supply voltage and the second primary supply voltage may have an upper limit bounded by a first reliability voltage value of 2.2 (2.0 multiplied by a tolerance factor of 10%). The primary supply voltage may have a lower limit bounded by 1.8 (2.0 multiplied by (one minus tolerance factor of .1) .9). The secondary supply voltage may have a lower limit bounded by 1.26 ((1.4) x (1 - .10)). A regulation scheme may also be defined in terms of voltage-current loadlines. The loadline for each required input voltage required value may have a continuous slope from the required value to within the lower limit of the supply voltages. The loadline may be continuous or discontinuous. The loadline may be linear or non-linear.

Claim 1, as amended, recites:

1. A power supply system, comprising:

a controller configured to cause a regulator to produce a principal supply voltage and a secondary supply voltage, said regulator for coupling to a power source and to a microelectronics device to supply said principal supply voltage and said secondary supply voltage to said microelectronics device;

wherein said controller is further configured to maintain said principal supply voltage within a tolerance level bounded at a principal supply upper limit

by a first reliability voltage value and bounded at a principal supply lower limit by a second reliability voltage value, and to maintain said secondary supply voltage within a second tolerance level bounded at a secondary supply upper limit by the first reliability voltage value and bounded at a secondary supply lower limit by a third reliability voltage value.

The Yang reference discloses a voltage regulator that employs a switching circuit having a pulse width modulator controlled by a high speed buffer circuit employed in a master-slave topology for fast response to rapidly changing load current. The voltage regulator regulates the supply voltage of a microprocessor within a tolerance band that does not exceed approximately 2 - 3%. *(Col. 1, lines 6 - 33.)* In a buck converter 10, the switching speed of a transistor 12 is controlled by the output of a comparator fed through a driver 15 and coupled to the gate of the transistor 12. The comparator has an inverting input connected to a signal that, in one example, oscillates between 0 and 2 volts, and a non-inverting input connected to a feedback loop to form a pulse- width modulator. The drain of the transistor 12 is connected to the input voltage and the source of the transistor 12 is connected to a first terminal of an inductor and the anode of a Shotky diode. The second terminal of the inductor 18 is connected to a first plate of a capacitor. The common connection of the second terminal of the inductor 18 and the first plate of the capacitor forms the output node for the output voltage. The output node is also coupled to a first end of a first impedance block in a feedback loop. A second end of the impedance block is coupled to the inverting input of error amplifier 26. A second impedance block 28 provides feedback to error amplifier 26. The non-inverting input of the error amplifier is connected to a reference potential. The output of

error amplifier 24 is connected to the inverting input of comparator 14 to complete the feedback loop of the transistor. *(Col. 2, lines 1 - 29).*

The Yang reference does not disclose, teach, or suggest the system in claim 1, as amended. Unlike the regulator in claim 1, as amended, the Yang reference does not show a power supply system, comprising: a controller configured to cause a regulator to produce a principal supply voltage and a secondary supply voltage, said regulator for coupling to a power source and to a microelectronics device to supply said principal supply voltage and said secondary supply voltage; wherein said controller is further configured to maintain said principal supply voltage within a tolerance level bounded at a principal supply upper limit by a first reliability voltage value and bounded at a principal supply lower limit by a second reliability voltage value, and to maintain said secondary supply voltage within a second tolerance level bounded at a secondary supply upper limit by the first reliability voltage value and bounded at a secondary supply lower limit by a third reliability voltage value.

Instead, the Yang discloses a voltage regulator with a controller to produce a principal supply voltage within a tolerance level, e.g. 2- 3%, as cited by col. 1, lines 30 - 33. Further, the Yang reference discloses voltage regulation of only a single input voltage. The Yang reference makes no mention of a power supply system, comprising a controller configured to cause a regulator to produce a principal supply voltage and a secondary supply voltage; wherein said controller is further configured to maintain said principal supply voltage within a tolerance level bounded at a principal supply upper limit by a first reliability

voltage value and bounded at a principal supply lower limit by a second reliability voltage value, *and to maintain said secondary supply voltage within a second tolerance level bounded at a secondary supply upper limit by the first reliability voltage value and bounded at a secondary supply lower limit by a third reliability voltage value.*

Accordingly, applicants respectfully submit that independent claim 1, as amended, distinguishes over the Yang reference.

The Henze reference does not make up for the deficiencies of the Yang reference. The Henze reference relates to a regulator circuit for equalizing the load currents of a plurality of power supply modules connected in common to feed a common load. *(Col. 2, line 64 - Col. 3, lines 15, Abstract of the Invention.)* Each of the modules include a modulator responsive to an externally produced pulse-width signal for adjusting the duty cycle of the module, thereby incrementally adjusting the voltage output of the module. The regulator includes a current sensor responsive to a load current which is indicative of the current output of the module. The voltage developed across the load of the module is used to provide a variable voltage signal proportional to the load current. An amplifier is responsive to the variable voltage signal and a reference voltage signal and generates a pulse-width signal such that the duty cycle of the modulator is adjusted to decrease the load voltage in accordance with a decrease in current output. The pulse width signal is applied to the modulator so that the duty cycle of the module is adjusted to substantially equalize the load current of the control module with each of the plurality of power supply modules, wherein each of the modules is adjusted substantially independently of the current provided by all of the

other modules. Each module provides substantially the same regulated output voltage. *(Col. 2, line 59 - col. 3, line 18.)*

The Henze reference does not disclose, teach, or suggest the system in claim 1, as amended. Unlike the apparatus in claim 1, as amended, the Henze reference does not show a power supply system, comprising: a controller configured to cause a regulator to produce a principal supply voltage and a secondary supply voltage, said regulator for coupling to a power source and to a microelectronics device to supply said principal supply voltage and said secondary supply voltage to said microelectronics device; and wherein said controller is further configured to maintain said principal supply voltage within a tolerance level bounded at a principal supply upper limit by a first reliability voltage value and bounded at a principal supply lower limit by a second reliability voltage value, and to maintain said secondary supply voltage within a second tolerance level bounded at a secondary supply upper limit by the first reliability voltage value and bounded at a secondary supply lower limit by a third reliability voltage value.

Instead the Henze reference is directed to providing a regulator circuit for equalizing the load currents of a plurality of power supply modules connected in common to feed a common load. The Henze reference does not show a power supply system, comprising a controller configured to cause a regulator to produce a principal supply voltage and a secondary supply voltage because the Henze reference utilizes multiple power supply modules to feed a common load, i.e., to produce one supply voltage. Accordingly, applicants respectfully submit

i.e., to produce one supply voltage. Accordingly, applicants respectfully submit that claim 1, as amended, distinguishes over the Henze reference, alone or in combination with the Yang reference.

Independent claims 13 and 19 recite limitations similar to independent claim 1, as amended. Accordingly, applicants respectfully submit that independent claims 13 and 19 distinguish over the Yang reference and the Henze reference, alone or in combination, for the reasons set forth above with respect to independent claim 1, as amended.

New claim 31, dependent off of claim 1, further distinguishes over the Yang and the Henze references, alone or in combination. New claim 31, recites:

The power supply system of claim 1, wherein said second reliability voltage value is determined by multiplying one minus said tolerance level by a first input voltage required value and said third reliability voltage value is determined by multiplying one minus said second tolerance level by a second input voltage required value.

Neither the Yang reference nor the Henze reference discloses, teaches, or suggests the system in new claim 31. The Yang reference discloses a tolerance band of 3% buts does not discuss multiple input voltage required values, i.e., a second reliability voltage value and a third reliability voltage value, nor does it discuss how the multiple reliability voltage values are determined. The Henze reference is not found to disclose a discussion of how reliability voltage values are determined. According, applicants respectfully submit that new claim 31 distinguishes over the Yang reference and the Henze reference, alone or in combination. New claim 32 and claim 22, as amended, involve similar limitations to new claim 31. Thus, applicants respectfully

submit that new claim 32 and claim 22, as amended, further distinguish over the Yang reference and the Henze reference, alone or in combination.

Claims 2 - 6, 14 - 18, 20, 22 - 26, and 28 - 30, all as amended, depend directly or indirectly from independent claim 1, 13, and 19, as all amended. Accordingly, applicants respectfully submit that claims 2 - 6, 14 - 18, 22 - 26, and 28 - 30, all as amended, distinguish over the Yang reference and the Henze reference, alone or in combination, for the reasons set forth above with respect to independent claim 1, as amended.

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Applicants believe that the foregoing amendments place the application in condition for allowance, and a favorable action is respectfully requested. If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call either of the undersigned attorneys at the Los Angeles telephone number (213) 488-7100 to discuss the steps necessary for placing the application in condition for allowance should the Examiner believe that such a telephone conference would advance prosecution of the application.

Respectfully submitted,

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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE IN THE SPECIFICATION

Replace paragraph 22 on pages 5 and 6, as follows:

Figure 3 illustrates a regulation scheme in accordance with an embodiment of the present invention. Referring to Figure 3, a principal supply voltage [(Vcc1)] is still operated within a 10% tolerance window or level with an upper limit bounded by reliability voltage value V_{ccx}, as was the case for Figure 1. However, for the present embodiment the secondary supply voltage is operated within a range having an upper limit that is the same as for [V_{cc1} or lower and bounded by the higher value of the two (i.e., $V_{cc2} = V_{cc1}$ for purposes of calculating the upper limit for a particular tolerance level and by reliability voltage value V_{ccx}, and principal supply voltage (V_{cc1}) is operated within a range having a lower limit which may be equal to the lesser of the products of a tolerance level multiplied by the lower of the two.] the principal supply voltage<u>, i.e., V_{ccx}. The principal supply voltage is operated within a range having a lower limit of the .90 multiplied by a first input voltage required value (V_{cc1}), i.e., .90 x V_{cc1} or one minus the tolerance level 10% multiplied by the first input voltage required value. The secondary supply voltage, V_{cc2}, is operated within a range having a lower limit of .90 multiplied by a second input voltage required value (V_{cc2}), i.e. .90 x V_{cc2}, or one minus the tolerance level (10%) multiplied by the second input voltage required value. For example, if V_{cc2} is 1.4 volts, the lower limit of the range that the secondary supply voltage V_{cc2} is operated within would be 1.26, or (.9 x 1.4).</u>

Replace paragraph 25 on page 6

A regulating scheme in accordance with an embodiment of the present invention is further described using an exemplary numerical example in reference to Figure 3. Referring to Figure 3, the second input voltage required value, V_{cc2}, where $V_{cc2} < V_{cc1}$, may be for example, 1.4 V_{DC}, and the first input voltage required value, V_{cc1}, may be, for example, 2.0 V_{DC}. As shown in Fig. 2, for each different input voltage required value, the regulator provided in accordance with an embodiment may maintain each of the distinct input voltages presented to microelectronics device 30 within the same upper limit, V_{ccx}, which is the same upper limit for V_{cc1}. However, the regulator provided in accordance with the embodiment may maintain the lower limit for the second input voltage required value, V_{cc2} (1.4 V_{DC}, for example), equal to the lesser of the product[s] of <u>one minus</u> the tolerance level (in this example [10%]) multiplied by the first input voltage required value (2.0 V_{DC}) and <u>one minus</u> the tolerance level multiplied by the second input voltage required value (1.4 V_{DC}). In the exemplary regulating scheme of Figure 3, this determination yields a lower limit of 1.26 V_{DC}, thus giving the power supply in accordance with an embodiment a dynamic window <u>from the second input voltage required value</u>, [or input voltage range,] of 740 mV instead of the relatively tight range of 140 mV.

Replace paragraph 32 on page 9.

Referring now to Figure 7, microelectronics device 30 may be, for example, designed to operate using two [different supply voltages] <u>input voltage required values</u>, V_{cc1} and V_{cc2}. In this case the regulator circuit 300 provided in

accordance with an embodiment may include two conceptually distinct regulator circuits 310 and 315. As shown in Figure 7, regulator circuit 310 may be used to provide power supply regulation for a <u>principal supply voltage to track a</u> first input voltage required value, V_{cc1}, while regulator circuit 315 may be used to provide power supply regulation for a <u>secondary supply voltage to track a</u> second input voltage required value, V_{cc2}, in accordance with an embodiment. In an embodiment, the first input voltage required value, V_{cc1}, may be a higher input voltage of, for example, 2.0 V_{DC}, while the second input voltage required value, V_{cc2}, may be a lower input voltage of, for example, 1.4 V_{DC}. In an exemplary embodiment of Figure 7, regulator circuits 310 and 315 are each provided in accordance with buck technology. The corresponding exemplary buck regulator embodiment shown in Figure 7 includes the appropriate suffixes (e.g., "1" and "2") to designated a component regulating <u>the principal supply voltage and the secondary supply voltage to track</u> the first or second input voltage required values, respectively. While shown schematically as being logically separate, the components of regulator circuits 310 and 315 may be implemented using one or more of the same components, or different components, without departing from the scope of the present invention.

<u>IN THE CLAIMS</u>:

Please cancel claims 7 - 12, and 21, without prejudice. Please add claims 31 and 32. Claims 1 - 6, 13, 15 - 19, 22 - 26, and 28 - 30 have been amended, as follows:

1. (Amended) A power supply [regulator] <u>system</u>, comprising:

a controller configured to cause [said] a regulator to produce [more than one regulated input voltage] a principal supply voltage and a secondary supply voltage, said regulator for coupl[ed]ing to a power source[,] and [said regulator coupled] to a microelectronics device [for] to supply[ing] said [regulated input voltages] principal supply voltage and said secondary supply voltage to said microelectronics device; and

[wherein said controller is configured to produce a particular one of said regulated input voltages for each of a plurality of different input voltage required values;]

wherein said controller is further configured to maintain [each said regulated input voltage within an input voltage range bounded by a constant upper limit and a lower limit; and] said principal supply voltage within a tolerance level bounded at a principal supply upper limit by a first reliability voltage value and bounded at a principal supply lower limit by a second reliability voltage value, and to maintain said secondary supply voltage within a second tolerance level bounded at a secondary supply upper limit by the first reliability voltage value and bounded at a secondary supply lower limit by a third reliability voltage value.

[wherein said lower limit is determined in accordance with a gain factor in accordance wit a voltage current loadline.]

2. (Amended) The [regulator] system of claim 1, wherein the [number of said regulated input voltages is two] controller causes said regulator to produce a third supply voltage and the controller is configured to maintain said

third supply voltage within a third tolerance level bounded at a third supply upper limit by a first reliability voltage value and bounded at the third supply lower limit by a fourth reliability voltage value.

3. (Amended) The [regulator] system of claim 1, wherein [said controller is further configured to determine said gain factor in order to produce said regulated input voltages according to said loadline, wherein said loadline specifies a linear relationship for said plurality of said regulated input voltage required values, and wherein said lower limit is equal to the lesser of the products of a tolerance level multiplied by each said input voltage required value] the principal supply voltage and the secondary supply voltage are determined in accordance with a gain factor in accordance with a voltage-current loadline.

4. (Amended) The [regulator] system of claim [1]3, wherein said controller is further configured to determine said gain factor as required to produce [said regulated input voltages] the principal supply voltage and the secondary supply voltage according to said voltage-current loadline and [wherein] said voltage-current loadline specifies a [total power voltage-current] linear relationship.

5. The [regulator] system of claim [1]3, wherein said controller is further configured to determine said gain factor as required to produce [said regulated input voltages] the principal supply voltage and the secondary supply voltage according to said voltage-current loadline and said voltage-current loadline specifies a [non-linear relationship for said plurality of input voltage required values] total power voltage-current relationship.

6. The [regulator] system of claim [5]3, wherein said controller is further

configured to determine said gain factor in order to produce the primary supply voltage and the secondary supply voltage according to said voltage-current loadline and said voltage-current loadline specifies a non-linear relationship and said non-linear loadline further includes a discontinuity corresponding to an immediate current value between zero and a maximum[, associated with said microelectronics device].

13. (Amended) A regulator, comprising:

at least two regulator circuits, each said regulator circuit for coupl[ed]ing to a microelectronics device [for] to provid[ing]e a plurality of regulated input voltages to said microelectronics device, wherein each said regulat[ed]or circuit provides a particular one of said regulated input voltages to said microelectronics device;

wherein each said regulator circuit further [comprises] includes:

a controller including a comparator and a threshold detector, an input of said comparator being coupled to the output of said threshold detector,

a switch coupled to said controller and opera[ble]ting in response to a signal provided by said controller, said switch connected to an inductor, a diode, and an output capacitor arranged in a network that produces a load current in response to an input source voltage received via said switch, and

a current sense feedback network connected to said network output and having a gain factor, said feedback network coupled to said threshold detector to cause said threshold detector to produce an output signal as a product of said gain factor,

wherein said controller is configured to produce one of said plurality of said regulated input voltages by varying the duty cycle of said switch in accordance with a voltage current loadline,

wherein said controller is further configured to maintain said one of regulated input voltages within an input voltage range bounded [by a constant] at an upper limit by a first reliability voltage value and *bounded at* a lower limit, and

wherein said lower limit for said one of said plurality of regulated input voltages is computed by said controller in order to maintain said one of said plurality of regulated input voltages in accordance with said voltage-current loadline of said one of said plurality of regulated input voltages for different values of said load current.

15. (Amended) The regulator of claim 13, wherein said voltage-current loadline specifies a linear relationship [between said input voltage required values].

16. (Amended) The regulator of claim 13, wherein said controller computers a gain factor for said one of said plurality of regulated input voltages in order to maintain said one of said plurality of regulated input voltages according to a total power voltage-current loadline.

17. (Amended) The regulator of claim 14, wherein said voltage-current loadline specifies a non-linear relationship [between said input voltage required values].

18. (Amended) The regulator of claim 17 wherein said [non-linear] voltage-current loadline with a non-linear relationship includes a discontinuity corresponding to an immediate current value between zero and a maximum associated with said microelectronics device.

19. (Amended) An electronic system, comprising:

a [microprocessor requiring] microelectronics device having at least two input voltage required values to receive at least two input supply voltages;

a regulator coupled to said microelectronics device; and

a power source coupled to said regulator;

wherein said regulator is configured to produce said at least two supply voltages within an input voltage range bounded by an upper limit and a lower limit;

wherein said upper limit [is constant for] of each of said at least two input supply voltages is a first reliability voltage value; and

wherein said lower limit of each of said at least two input supply voltages is determined by a gain factor multiplied by each of said at least two input supply voltage required values.

22. (Amended) The electronic system of claim 19, wherein said regulator is further configured to determine said gain factor for each of said at least two input supply voltages according to a voltage-current loadline, and wherein said lower limit for each of said at least two input supply voltages is equal to the [less of the] product[s] of one minus a tolerance level multiplied by a corresponding one of the at least two input supply voltage required values.

23. (Amended) The electronic system of claim 19, wherein said regulator adjusts said gain factor to produce said [regulated input voltages] at least two input supply voltages according to a voltage-current loadline, and wherein said loadline specifies a total power voltage current relationship.

24. (Amended) The electronic system of claim 19, wherein said regulator adjusts said gain factor to produce said [regulated input voltages] at least two input supply voltages according to a voltage-current loadline, and wherein said loadline specifies a non-linear relationship [for said plurality of input voltage required values].

25. (Amended) The electronic system of claim 24, wherein said non-linear

loadline] <u>relationship</u> includes a discontinuity corresponding to an intermediate current value between zero and <u>a</u> maximum, associated with said microelectronics device.

26. (Amended) A regulating method, comprising:

supplying multiple input voltages to one or more microelectronics devices, <u>each of</u> said multiple input voltages including a [plurality of] <u>corresponding</u> input voltage required value[s];

determining a lower limit of a voltage regulation range for said multiple input voltages in accordance with a <u>corresponding</u> voltage-current loadline; and

maintaining each of said multiple input voltages supplied to said microelectronics devices [within] <u>above</u> <u>said lower limit of said voltage regulation</u> range and under said first reliability voltage.

28. (Amended) The method of claim 26, wherein said determining further includes selecting a gain factor in order to produce said [regulated] multiple input voltages according to said <u>corresponding voltage-current</u> loadline, wherein said <u>corresponding voltage-current</u> loadline specifies a linear relationship [for said plurlality of said regulated input voltage required values] <u>and</u>
wherein lower limit is equal to the [lesser of] the product[s] of a tolerance level multiplied by [each] said <u>corresponding</u> input voltage required value.

29. (Amended) The method of claim 28, wherein said determining further includes adjusting a gain factor as required to produce said [regulated] <u>multiple</u> input voltages according to said corresponding voltage-current loadline, where said corresponding voltage-current loadline is a total power voltage-current loadline.

30. (Amended) The method of claim 28, wherein said determining

further includes adjusting a gain factor as required to produce said [regulated] multiple input voltages according to said corresponding voltage-current loadline, where said corresponding voltage-current loadline specifies a non-linear relationship.

31. (New) The power supply system of claim 1, wherein said second reliability voltage value is determined by multiplying one minus said tolerance level by a first input voltage required value and said third reliability voltage value is determined by multiplying one minus said second tolerance level by a second input voltage required value.

32. (New) The regulator of claim 13, wherein said lower limit for said one of a plurality of regulated input voltages is determined by multiplying one minus a tolerance level by a corresponding one of a plurality of input voltage required values.